The Glass Industry
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Physics in the Glass Industry

By F. W. Preston[1]

THERE are some industries, like the electrical and radio industries, which had their origin in deliberate scientific experiments and have been guided by experiments in physical science ever since. These industries are perhaps the most characteristic ones of our age; they are the scientific industries.

There are others which are the gradually involved product of ancient handicrafts. Such are the iron and glass industries. They are characterized more by the recent development of great and complicated machine operations rather than by the profundity of the science involved. It is the engineer rather than the physicist who has given the modern twist to these ancient arts.

Structural steel of today, considered metallurgically, may be better than that of a few centuries ago, but even that is doubtful, except in respect of particular features. The thing that gives modern structural steel its importance is the size of the furnaces in which it is made, the spectacular processing through the blooming mills and the finishing rolls, and the extraordinary cheapness of the final product, not its phenomenal physical properties.

The same thing is true of glass. Glass is used in much greater tonnage than ever before, and it is cheap; but except for a few developments that sell in comparatively small amounts, the glass of today is not chemically or physically any better than it was many years ago.

In the matter of dollars and cents, plate glass probably takes pride of place as the largest single item in the country's production. But chemically and physically it is no different from the glass of fifty or a hundred years ago. It has the same optical properties, the same mechanical deficiencies, the same resistance or lack of resistance to the weather. Even the processes of grinding and polishing it are physically identical with the most ancient ones. What has changed is the machinery; it is made today on larger, better, more efficient, and in every way superior machines, but by essentially the same physical process and the product itself is physically the same.

An important industry has developed in wire glass. This is really an offshoot of the plate glass industry, and differs from it only in that efforts are made to put a mesh of chicken wire inside the glass, and less effort is given to obtaining a perfect "metal" or a perfect mirror polish. But the development, producing an industry of no mean size, has been the work of mechanics and engineers, not of physicists. The physicist would know better than to try to put iron wire into glass.

A revolution has been effected in the window glass industry: the old processes of hand-making of window glass have disappeared: the hard slaving workmen are a thing of the past. A quiet machine, without attendants, draws the glass upwards from the tranquil bath in a never-ending ribbon. But this again is not the work of the physicist but of visionary engineers. Practically nothing is known to this day of the physics of the process.

It was found that the new process was apt to give devitrified (partly-crystallized) glass, and this tendency could be curbed to a large extent by adding a little magnesia to the batch. Physicists have since proved that the addition of magnesia is beneficial. The engineers found it out some twenty years before.

The above three divisions constitute the flat glass branches of the glass industries, and the contribution of the physicist to them has been almost nil. If any physics was used it was worked out empirically by non-physicists, and the industries are a monument essentially to their engineers, not to their scientists.

There have, however, been one or two infiltrations of scientific ideas; in particular, pyrometers are in general use for measuring temperatures. But more than that, two distinctly novel types of window glass are being produced; one of them is a glass that will transmit a fair proportion of the ultraviolet rays of the sun, and the other is a glass that will absorb the infra-red rays. No small business is now being done in both of these, and they represent definite contributions of the physicist to the industry.

The ultraviolet transmitting glasses are essentially glasses of ordinary composition, except that the iron-content has been partly reduced. Perhaps there is an unintentional pun here, for the iron content is not only reduced in quantity but is reduced, as far as practicable, from the ferric to the ferrous state.

The iron content of ordinary glasses, is quite low, the iron

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being present only as an accidental impurity, mostly from the sand. But a small fraction of one percent. of iron oxide has a disastrous effect on the ultraviolet transmission.

The near ultraviolet contains frequencies of apparently great importance to the health of anthropoids. The new glass has been of great benefit to the monkeys in the zoos. It might also be of benefit to human beings if they would stay near the window with their clothes off, but up to date difficulties have been encountered in this matter, and the principal benefits to human beings from the new glasses seem to have been psychological.

Even in the new glass, the iron content, though reduced, is not zero, and it is found that the state of oxidation of the iron changes with the radiation to which it is exposed. It will oxidize in sunlight, and still more in mercury arc-light. the process is known as "solarization," and an arc solarized glass can be deoxidized to some extent by exposure to sunlight. The transmission of ultraviolet changes with the solarization. The phenomenon is not yet entirely understood, and work is proceeding in several laboratories on the subject.

The infra-red absorbing glasses are generally glasses containing large amounts (1% or more) of iron oxide. The iron may be in the oxidized or reduced condition, and other oxides may be added to modify the color since all such iron-bearing glasses are necessarily not white. One of the most satisfactory of these glasses is of an unsaturated yellow tint, and the curious effect is noticed that though the glass absorbs some of the daylight, yet an indoor tennis court glazed with this glass appears more brightly lit (on a dull day) than outdoors. This is a psychological matter of course, or a physiological one; but it was the physicists who hit on the idea and contributed something definite to the industry.

We leave now the flat glass industry and turn to another great branch—the glass container industry. Glass containers are mainly glass jars and bottles. This again is a tonnage proposition in most instances. There are many tanks in the country delivering forty tons or more of bottles per day.

The history of a glass bottle is simple. It is first of all "batch"—a mixture of sand, lime and soda; then it is fired and fluxed in a tank, delivered to a bottle-making machine, annealed and packed. The outstanding modern developments have been the bottle-making machines. These are entirely a product of the engineer, and wonderful pieces of mechanism. They are of two types, one of which itself takes the glass from the tank, and the other of which is supplied with glass by an auxiliary machine called the "feeder." The feeder is not a machine of the ordinary type, since it never really has a hold on its glass, but the "gobs" or masses of fluid glass that go to form a bottle depend for their accuracy and perfection not simply on the machine itself, but on the viscosity, inertia, and other properties of the glass itself. Thus what the feeder does depends greatly on the temperature and composition of the glass, which must accordingly be more accurately controlled than for hand working. These, however, are not particularly recondite matters of physics, and they were worked out by engineers on a more or less empirical basis.

The annealing process is essentially a physical rather than an engineering process, and important contributions to our knowledge of the subject have been made by a small band of physicists. Nevertheless, except in a very general way, little use has been made of these investigations in the bottle industry, and none at all in the flat glass industry. There, everything was worked out empirically to suit the machines; the machines were not designed to suit the physics of the process. It is accordingly possible that we shall some day see improvements here inaugurated by the physicist.

The physicist has introduced testing appliances in both the bottle and the flat glass industries: the chief instrument is the polariscope and the wisdom of its introduction is questionable. Too much discrimination is necessary in interpreting its findings. Certain other tests, more of an engineering character, such as hydraulic pressure tests, thermal shock-tests, impact, and bending tests, have also been introduced and in general are more useful up to the present time.

The melting process is one of which our knowledge of the physics is very incomplete. Some consideration has been given to the circulation of the glass in the tank, the mechanism of penetration of the heat into the glass, the elimination of the bubbles from the glass, and so on, but no very profound results have yet emerged. Such progress as has been obtained has been by empirical experimenting, generally by unsophisticated works managers and engineers. It is, however, so obviously a physical process and so vilely carried out at the present time, that improvements must alternately be sought, and the physicist may come into his own.

One great problem in the melting process is the fluxing action of the glass on the refractories. The physicist has shown that there is a compound of alumina and silica, which he calls mullite, which is present in most refractory blocks and determines in a great measure the value of the refractory. A recent development, due entirely to the physicist, is the preparation of fused mullite, therefore, for tank refractories. Up to date the results have been distinctly encouraging.

Bottles are commonly divided into two categories "flint" and "colored." "Flint" therefore means "white" or "colorless." The colors used to be mainly green ("beer") and amber. The green is largely a matter of the iron content. In recent years color has become a more important matter, and a great variety of colors, including yellows due to such comparatively rare metals as uranium, are becoming increasingly common. The number of queer oxides going into glass for mere coloring effects is indeed remarkable, and the possibility of some of the newer colors on the dinner table being produced at all depends in the ultimate analysis on the physicist's having scoured the earth for elements missing from the periodic table.

Rare earths are also being used in no small amounts to produce eye-protecting glasses, especially glasses to protect the eyes of furnace operators, who are otherwise likely to get cataract. Didymium is one of the rare metals thus employed, and its use is due directly to the physicist. The spectral-transmission curve of didymium is a joy to behold;

it looks like nothing so much as the death agonies of a sea-serpent.

The physicist has produced also certain other strange glasses by the addition of special oxides: For instance, a black glass, quite opaque to visible light, but transmitting the ultraviolet. This can be used in conjunction with an iron-arc, say, to produce strange fluorescent phenomena in a piece of uranium glass, or for other experiments on fluorescence. But up to date it remains largely a scientific curiosity.

The pressed glass-ware branch and the pressed and blown ware, which includes most of the ware on the dinner table, owe very little to the physicist, and less to the engineer than the other branches. It is largely an artist's field, and its methods are comparatively primitive. The physicist has contributed some new colors, perhaps, and the engineer some rather prehistoric-looking machines; but there is very little science and a great deal of art in it all.

The electric lamp bulb business, and its recent offspring, the radio tube business, has produced some phenomenal works of engineering, culminating in a continuous bulb-blowing machine, which blows bulbs like so many blisters on a rapidly travelling-ribbon of red hot glass.

The physicist has had a fair innings on these new products. An excellent example of his work was the development of the inside "frosting" of such bulbs, which gives a less glaring and distressing light than the plain glass, and puts the frosting where it will not collect dirt. The engineer proposed to get the result by shaking sand in the bulb, a slow and imperfect process. The physicist got it in a few seconds with a series of acid rinses. The big difficulty was to avoid producing brittleness, and this the physicist succeeded in doing. The etching acid is followed by a water rinse, and then by a "fortifying solution," all in the matter of a few seconds.

The radio tube business presents special problems of its own. Some radio tubes run quite hot, for the electric circuit is not completed through metal, but only by thermionic emission from hot plates. This throws a high potential on the heated glass of the stems, and electrolysis of the glass is apt to occur. Electrolysis of glass usually means migration of sodium ions, and the problem of the physicist is to produce a glass free from the electrolytic difficulty which shall at the same time be acceptable to the operators of the machines on which the bulbs are made.

A very important, but far from voluminous, branch of the glass industry is the scientific glassware branch. Scientific glass is of two main kinds—optical glass and chemical ware. In both of these the physicist has had a great deal to say, since to no small extent the physicist and chemist are not merely the producers but the consumers of the product.

The modern optical glass business in a very great measure owes its form to Abbé and Schott, who undertook the apparently very obvious line of inquiring what the effects of all practicable oxides were on the optical properties of glass. The idea is simple, and it merely means an immense amount of work to answer the question. Diligence rather than genius seems to be the requisite; but few researches have been more important than this, which inaugurated a new era in the glass industry. It was simply an elementary physics problem, but needing no small expenditure to carry it through. The story has been told so often that it will not be repeated here.

There have been many inquiries on similar lines since, and in fact they are still in process, at the Bureau of Standards among other places. And curiously enough, we are not yet satisfied with the findings even in the case of that eternal triangle—Soda-Lime-Silica, the oldest and still the commonest glass.

The problem of the chemical resistance of glass is ever with us. Up to date the researches have been numerous, but entirely empirical. Glasses have long been known with a high degree of resistance to most chemicals.

A new aspect to this question was presented when the Pyrex glasses were developed in this country. These glasses were originally developed with the idea of producing a thermal-shock-resistant glass. For this purpose a glass was needed with a very low coefficient of expansion. Such a glass was not to be found in the soda-lime-silica series or in the potash-lead-silica series, but it was found in an alumino-boro-silicate composition. The thermal expansion was only one third that of the soda-lime glasses.

This glass, however, was a high-melting-point glass, and the furnaces in which it is made run a hundred degrees or more hotter than the ordinary commercial furnaces. The glass, as might perhaps be expected, is correspondingly resistant to chemical attack, so that two birds were killed with one stone when it was invented.

For most kinds of laboratory chemical ware it is well adapted, being resistant not only to the chemicals, but to the thermal maltreatment. For beakers and flasks it is excellent.

But this is only the beginning, for since it can be handled in great masses and annealed without difficulty, it can be used in vastly larger sizes than ordinary glass, and gives the glass industry an opening into the structural field in competition with the metal and ceramic wares. It can be used for great conduits, pipes, or tanks, and for even more definitely structural uses.

The inventors of the glass would be regarded as chemists rather than physicists, but the problem was a physical one, not a chemical one. Accordingly we may regard this as an outstanding achievement in the application of physics to the glass industry.

A slight modification of the old Pyrex formula gives us electrically-resistant Pyrex. This is being used for insulators on high-tension lines with great success. The problems of producing an article adapted to stand simultaneously the great weight of the cable and the great electric potential are partly engineering, partly physicist's, problems, and they are being met very successfully.

The Pyrex glasses are being used increasingly for domestic cooking and similar purposes, and generally we can say that the invention Pyrex is the outstanding physicists' contribution to the glass industry since the development of the modern optical glasses by Abbé and Schott.

Incidentally we may mention in passing that in a hot oven

water will boil and the dinner will cook faster in a thick glass vessel than in a thin silver or iron one. This, the physicist points out, is because glass is a good absorber of oven-heat, while silver reflects the heat away from itself.

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The above is a somewhat sketchy review of the glass industry and a still more partial view of the physicists' activities in it. The physicist is a comparative newcomer in this industry, and he has lately been piling up some formidable work, which as yet has little bearing on the industry, but may sooner or later have a great bearing upon glass.

There is a great deal of work going on to give more precision to our ideas of the "glassy state."

One line of attack is the investigation of the devitrification of glasses. Any glass, if cooled very slowly from a very high temperature will sooner or later reach a temperature at which crystals separate out. The composition of these crystals varies of course with the character of the glass, and further, their rate of deposition varies greatly with the character of the glass too. The investigation of the "liquidus" temperature (highest temperature at which the reaction glass → crystal proceeds) and of the fields of composition with which the different sorts of crystal are stable, has been pursued vigorously in the Geophysical Laboratories of Washington in recent years, while from Germany we have had interesting studies on the rate of reaction, glass → crystal, at various temperatures below the liquidus.

Another line of attack is the X-ray analysis of glasses, which up to date seems to have produced nothing but confusion, but this may not continue for ever.

The investigation of the viscosity of molten glasses, and of glasses gradually stiffening down to the annealing point, has now been in progress for some years. The work is tedious, but some considerable body of experimental data is now available. The theory of the subject is in complete chaos.

Paralleling the viscosity tests have gone investigations of the electrical conductivity of molten glass. These tests can be carried to a lower temperature than viscosity tests, and a great many phenomena have been discovered. Slightly strained glass, for instance, has a much higher conductivity than well-annealed glass. There is hope that we may learn a great deal about the constitution of glasses from such tests.

Strange results have also been found in the variation of refractive index and density with a slight change in the annealing temperature, showing that a glass of given composition is not necessarily of a given physical composition, even when well-annealed.

The mechanical properties of glass have come in for some scientific attention of late, and it has been found that the breaking of glass does not resemble the breaking of metals, and that it cannot be accounted for in any of the simple theories of elastic deformation. There are good grounds for the hope that glass may ultimately be produced of a strength vastly exceeding anything at present available.

The numerous researches on the ultimate nature of glass now dotting the landscape of the scientific world are the advance guard of skirmishers spying out a strange and difficult land. The boom of heavier artillery will shortly be heard as the points of resistance are located and the main army sweeps into action; and when the defenses go down, mankind will have at his disposal a material of far greater worth than ever he thought possible.

Leakage of Helium Through Pyrex

IN a recent number of *Science*, G. P. Baxter and H. W. Starkweather report additional evidence of the slow leakage of helium from a sealed Pyrex globe at room temperature. The gas in the globe was originally under slightly less than atmospheric pressure (75 cm.) and the globe was occasionally compared in weight with a similar sealed globe containing argon under a pressure of 79 cm.

It was stated that in the course of a year the helium globe lost in weight an amount corresponding to a little over 1 per cent of the helium. Moreover, in the three and one-half years since the experiment started the proportion of helium which apparently had diffused through the glass was nearly 3.5 per cent (35 ml.). The rate of leakage per day was somewhat irregular, although a continuously slower rate was to be expected on account of the diminishing interior pressure.

The globe contained 1044 m. of gas. The following table, reproduced from *Science* gives in detail the results of the measurements by Baxter and Starkweather:

Date	Excess in wt. of counterpoise over globe g.	Time days.	Loss in wt. mg.	Loss in wt. per day mg.
Nov. 11, 1927	8.08873	0	....	.....
Nov. 11, 1928	8.09046	366	1.73	0.00474
Feb. 2, 1929	8.09091	449	2.18	0.00486
April 25, 1929	8.09141	531	2.68	0.00505
May 2, 1929	8.09144	538	2.71	0.00505
June 28, 1929	8.09179	595	3.06	0.00515
March 25, 1931	8.09445	1230	5.72	0.00465
May 22, 1931	8.09500	1288	6.27	0.00488
May 23, 1931	8.09491	1289	6.18	0.00479
May 25, 1931	8.09496	1291	6.23	0.00482

New Arrangements for Publishing Monographs

Engineering Societies Library, New York, announced a while ago the completion of arrangements for the publication of a series of technical treatises to be known as Engineering Societies Monographs. The editorial supervision of this series will be in the hands of a committee consisting of Harrison W. Craver, Director of Engineering Societies Library, Chairman, and two representatives appointed by each of the following engineering societies: American Society of Civil Engineers, American Institute of Mining and Metallurgical Engineers, The American Society of Mechanical Engineers and American Institute of Electrical Engineers.

For many years those who have been interested in the publication of papers, articles and books devoted to engineering topics have been impressed with the number of important technical manuscripts which have proved too extensive, on the one hand, for publication in the periodicals or proceedings of engineering societies, or in other journals, and of too specialized a character, on the other hand, to justify ordinary commercial publication in book form.

No adequate funds or other means of publication have been provided in the engineering field for making these works available to the profession.

The aim is to make promptly accessible to many users information which otherwise would be long delayed in reaching more than a few, in the wide domains of engineering.

The first volume projected for the series is on Plasticity.

Summer Meeting of American Glass Technologists

THE GANG
Arthus Kines in a Hurry (Right); the Rest Comfortable After Breakfast.

IN deference to Dr. Finn's protest last February against Dr. Littleton's proposals to hold the third summer meeting in the Canadian "Northwest," it was held on the 12th and 13th of September in the tropics. Beneath a fiery and unrelenting sky the perspiring contingents from the north sought to hold up their end of the debate with the hard-boiled representatives of Washington, D. C.

The weather was blamed on Walter Oakley, who is known to have devoted himself to boosting temperatures for some

MAKING DATES
(Title by Hettinger)

time past. It is said that he has been so successful that he has run off the end of the Fahrenheit scale, which is why Corning has to use Centigrade degrees to melt its glass.

The meeting was held principally at the Hotel Chamberlain, Old Point Comfort, within a few miles of where Dr. Littleton was born. Dr. Finn, who with Mr. Roche and Mr. Lyle, was on the committee responsible for the locale, is believed to have selected this location as a means of explaining Dr. Littleton's passion for the Canadian "Northwest."

The majority of the members assembled at Baltimore and went down the Chesapeake in the Old Bay Line boat. The Bay was calm and the irritated jellyfish went streaming phosphorently in the wake. Sam Scholes devoted himself to picking out the Antarctic constellations in these southern skies, while others looked for flying fish and sperm whales.

The party was chaperoned by Mr. Baker, representative of the line to whom our thanks are due for many kindnesses and much efficiency.

At the ungodly hour of 4:45 A. M. the members of the party were awakened to prepare to disembark. Through the Stygian night all that could be seen was the flashing of distant lighthouses and the street lights of Norfolk. The only sounds were the slow swish of the water past the drifting ship and the iron clang of bells upon the channel buoys.

As the sleepy members assembled in the bows, the bun-shaped sun sprang from the eastern water's rim and disclosed the Atlantic fleet at anchor in Hampton Roads, line on line of warlike ironmongery cluttering the peaceful waters of the Bay.

To everyone's disgust, the said fleet forebore to fire a salute of twenty-one guns, although Sir Joseph Porter, Ruler of the Queen's Navee, had come all the way from Moundsville, W. Va. This caused much hard feeling and Finn was very insistent that the whole party postpone its business and call in force on the Admiral and demand an explanation. This was done on Sunday morning and it is understood that things were fixed up to everyone's satisfaction, Dr. Finn himself later proposing a resolution that the secretary of the Division be instructed to write the Admiral accepting his apologies and informing him that the morning's entertainment would be taken in lieu of the more formal, but less informative, salute; or something to that effect.

A good Samaritan was Hettinger now, for he brought forth many pairs of tinted goggles, wherewith the party

AS IN BIBLICAL DAYS
Woman Appearing from Man's Ribs.

might contemplate the scintillating waters and the heat-vibrated land. And he gathered the flock together, both sheepish and goatish, and made them to be photographed; and Hommel did likewise, and Roy Blunt spared not the movie, even though the Eastman Kodak Company has taken advantage of hard times to increase the price of film.

When the fracas of landing was over and breakfast safely

below hatches, the Publications Committee, apparently consisting of Dr. Navias (voter) and Dr. Littleton (to count him, when he votes) convened a meeting of Ross Purdy and lesser fry to consider what is to be done about the vast volume of material in Columbus awaiting publication. It was decided that except for matter already on the waiting list, new papers would not be accepted for printing in the journal if they were also to appear elsewhere in the same language. This would relieve some of the pressure on the space, but the secretary was given wide powers of discriminative lengthy abstracts if it should seem advisable.

At this point Flint interrupted to remark that the tide was

WALTER OAKLEY, LOUIS NAVIAS, HAROLD WHITE, MRS. OAKLEY, MRS. WHITE. MR. WHITE REPRESENTED THE REFRACTORIES DIVISION OF THE AMERICAN CERAMIC SOCIETY.

WHOSE CHILD?
(Title by Hettinger)

A STUDY IN PATHOS

THE LANDLUBBERS LYING DOWN BELOW, BELOW, BELOW!

now turning; at first it was not clear whether he was referring to the general business depression or to Hazel-Atlas earnings, but it turned out that he wanted to go fishing and that the turn of tide was the right time for that. As soon as Dr. Littleton heard this, he hurriedly counted Dr. Navias' vote and adjourned the meeting.

Mr. Sherwood now proceeded to swim back and forth

A VERY ILLUSTRIOUS GATHERING
FINN: SHERWOOD: HILGENBERG: INSLEY: BAILEY

while some sought shady places to discuss private business, or the lack of it.

In the evening a state banquet was held, at which Ross Purdy distinguished himself by taking off his coat. The rest, less enterprising, continued to wear theirs for a time, but in the end were glad to follow his lead and would have liked to abandon their other garments also.

After the meal, Mr. Hettinger reported that he was hatching a scheme of some sort on behalf of the education committee, but although prodded by Dr. Navias, he refused to divulge its nature. We wish that all committees would keep their findings to themselves; it would save a lot of trouble.

Mr. Purdy followed with a brief statement as to the finances of the division. So far as we could ascertain, we were not in debt to the parent society at that time.

W. C. Taylor was now called upon to report on behalf of the Standards Committee. For some reason best known to themselves the German and English Societies have become afflicted with an ambition to standardize the queerest things. The American Society has been invited to collaborate. Mr. Taylor was in favor of collaborating, but of going very slow on the standardizing. He submitted a digest of some of the standards proposed by the European societies and asked for comments.

Dr. Littleton, with his usual painstaking courtesy, examined the proposals one after another. Some he found impracticable, some unnecessary, some ambiguous and some rather ridiculous. Dr. Navias was strongly in favor of standards, even if they were bad ones, but could not tolerate the ambiguity. R. A. Miller argued very cogently in favor of collaborating with the European societies, partly with a view to doing everything possible to be helpful, partly with a view to self defence against undesirable European domination. F. W. Preston described the activities of the European societies in the matter as pernicious, and unnecessary, and the proposals to date as absurd. He moved that we invite the European committees to abolish themselves, but the motion was not seconded. It was then moved, seconded and carried unanimously that the American Society (Glass Division) collaborate with the European societies. Mr. Bailey, Mr. Blunt, Mr. Sharp, Mr. Flint and others spoke on the subject, and it was clearly the feeling of the division that the collaboration was voted, not in approval, but in alarm.

It was proposed that the Standards Committee, consisting to date only of Mr. Taylor and Mr. Preston, be strengthened, and that a reasoned report on the whole subject be presented at the February meeting. Mr. Preston announced that he would endeavor to prepare for that meeting a study of the history and nature of Standards, on which subject he had at one time been at work for the Engineering Standards Committee of Great Britain, since it seemed to him that the proposals they had listened to were totally devoid of the essential spirit and purpose of standards.

The meeting now settled down to be amused, and on behalf of THE GLASS INDUSTRY, Mr. Krisko and Mr. Preston performed some experiments in mental magic, reading colors, playing-cards, numbers on a dollar bill, questions written by the audience and other things without seeing them; and finally Mr. Krisko projected his thoughts upon the audience and prophesied a word to be chosen by a number of the audience.

On Sunday evening a short debate was held on the general question of the choice of batches from an economic point of view. This subject was brought up by Mr. Sherwood and several speakers took part. But the boat for Baltimore was expected shortly and the debate was not completed. Mr. Flint moved that the matter be laid on the table for about ten years, till the data could be assembled to answer the questions raised. Later he announced privately he was going to do some work on the subject himself.

CALLING IN FORCE ON THE ADMIRAL
Sir Joseph Porter (Second from Bows); Cape Horn Taylor Acting as Mizzen Mast; Chief Pirate Purdy at or Near Helm.

We missed a number of familiar faces from the gathering. Some we know were absent for domestic reasons; others were at too great a distance, and still others presumably felt the business depression warranted their absence, and some, we suspect, had been in the tropics before.

So far as is known Ross Purdy did not go to church this time; he did his good turn by taking off his coat.—*F. W. P.*

All Photographs by E. L. Hettinger, Willson Products, Reading, Pa.

Art of Glass Painting Beautifully Illustrated

NEUE GLASMALKUNST. Text by Clemens Gahlen. Published by Reichsverband Deutscher Glasmalerein e.V. Printed by Alexander Duncker, Leipzig, 75 pages, price R. M. 2.85. This little book is an important review of the glass painting art of the present day. The introduction, consisting of less than a dozen pages and entitled "Historical and Fundamental" makes up the greater portion of the text. The body of the work consists of some thirty illustrations of modern examples of the glass painting art, each of which is accompanied by a short paragraph of explanation.

Anyone with a spark of the artist in his soul cannot help being thrilled merely by looking at the illustrations. The designs have about them a youthful vigor that is a surprise to anyone more familiar with the older examples of stained glass windows. They strike one forcibly as exemplifying a new era in one of the ancient arts.

Not only will architects and theologians find this delightful book of interest—any lover of art can find inspiration in its pages, whether or not he can read the text.—*D. E. S.*

The American Standards Year Book for 1931, published by American Standards Association, 29 West 39th Street, New York, includes a foreword by Charles F. Kettering, President of the General Motors Research Corporation, who declares that the lack of coordinated functioning within industries and between industries is a major cause of business fluctuations and states that the national standardization movement is making a definite forward step toward correction of this problem.

The Manufacture of Rolled Plate

By ERNST LUTZ *

(*Continued from the September, 1931, issue*)

This work has been revised, so far as the English and the technical expressions are concerned, by F. W. Preston, who has also added a number of notes relating in general to the special conditions of American practice; but it must be understood that the opinions expressed in the text are those of Mr. Lutz, and neither the Editor nor Dr. Preston accepts responsibility for them.

"IT was not so easy to make the polishing process a continuous one too. The polishing is done by the circular apparatus as follows: Before the operation begins, the felts are washed thoroughly before they are gradually supplied with rouge, thus exerting on the surface of the glass in the beginning a scraping and later on a rubbing effect. The last polish is conferred on the surface as the rouge is drying more and more, at last working with but a thin layer. This is limited by the point where the rouge becomes caked. These cakes may get loose, come under the felts, and spoil the polish with so-called polishing sleeks. The washing at the beginning of each polishing process is to remove the caked rouge from the felts. The continuous polishing line does not permit off-hand for the alternating working and washing of the felts. Therefore, the danger of incrustation of the felts and polishing sleeks constituted the most important problem in making the polishing process a continuous one. The difficulties were overcome in different ways. For the narrow tables of the Ford Motor Company it was an easy matter because all of the felts frequently come over the edges of the narrow tables and are so cleaned by scraping. Further, automobile glasses do not need so fine a polish as store front windows and sheets to be silvered. Therefore, the problem is of much greater importance to a polished plate glass manufacturer than it is to an automobile builder like the Ford Motor Company.

"The Pittsburgh Plate Glass Company solved the problem by installing the runner frames of their polishing apparatus so that they can be exchanged or tilted easily as described in the U. S. patents 1,501,327 of John H. Fox and 1,548,105 of Jacob Soderberg. After a certain period of time has elapsed, each of the runners is either tilted and the individual felts are cleaned by scraping or the whole runner frame is removed by a crane and exchanged for a freshly cleaned one.

"A different system was developed by the firm of Pilkington Brothers, Limited, the European pioneers of the continuous grinding and polishing line. According to U. S. patent 1,781,226 a truck carrying a pan made of tin is installed aside the line of tables. The polishing blocks are raised and the washing pan is pushed between the felts and the tables; then the runner frame is lowered and the felts washed by rotating on the tinplate and being watered at the same time.

"Another solution of the problem is found in the U. S. patent 1,582,808 of L. von Reis. The polishing machines travel in the same direction as the glass tables but with a slower motion. When they have arrived at the finishing end of the line of tables, they are taken off and automatically cleaned, whereupon they are returned and started anew at the starting end of the polishing process. The scheme of this is shown in Fig. 135 J[1].

"Fig. 135 F shows the continuous grinding line used by the General Motors Company (National Plate Glass Company's plant—lately acquired by the Libbey-Owens Ford Glass Company), where the felts are cleaned according to the L. v. Reis patent. This equipment consists of 2 parallel lines of tables about 750 ft. long, running in opposite directions. The tables are about 15 ft. wide and 13 ft. long, and travel forward on the first line and, at the finishing end, the glass which is ground and polished on one side is taken off. Then the tables are pushed over a sliding platform (seen in the foreground of the figure) to the second line of tables which travels backward, and the glasses are re-set with the polished sides down. In the figure the guide-ways of the tables and, at the right, the automatic washing device for the polishing felts can be recognized.

"While the constructions of the Ford Motor Company and of the Pittsburgh Plate Glass Company employ but one single grinding and polishing tool for the entire width of the glass to be treated, the constructions built according to the Pilkington and Heuze patents use several tools coordinated side by side. This arises from the great width of the tables. The working of so large a glass with one single tool would require a too big and too heavy tool. Therefore, several working tools are installed side by side in some such way as described in the German patent specification 375,925 (Figs. 134 and 135). In order to make the distribution of the working of the glass surface more uniformly spread over the entire width of the table, the holder of the tools gets a simultaneous oscillating motion. The uniformity can also be improved by the construction of oval tools (Fig. 135 K, grinding tool of the continuous grinding line of the Herzogenrather Glaswerke) or by displacing the shafts of the tools with respect to each other. (Figs. 135 L and 135M.) The latter figure shows the working curve of two polishing blocks. From this curve, the effect of the displaced shafts can be seen.

"Although the development of the continuous grinding

* Of Desseau, Germany. This work is appearing in German in the new edition of *Dralle-Keppeler*, "Die Glasfabrikation."

FOOTNOTE: In the Figures, originally prepared for use eventually in the new edition in the German language of *Dralle-Keppeler*, "Die Glasfabrikation" in 1931, dimensions are given in metres (*m*) and millimetres (*mm*). We would like to have given these in feet and inches but the translation and the making of nearly two hundred and fifty new illustrations would have involved a prohibitive loss of time and expense. To some of our readers the metric system is as familiar as the English units; for the others we may say that a metre is approximately 40 inches. and a millimetre is approximately 1/25 of an inch. A thousand millimetres, of course, go to a metre.—*F. W. P.*

[1] CORRECTION—In the September issue Fig. 135-J, sixth line below Fig. 135-O should read Fig. T.

and polishing line is not yet quite 10 years old, these machines have been introduced very quickly into the polished plate industry and taken the place of the old rotating polishing apparatus. The apparatus, with tables of up to 15 ft. widths and lines of more than 1,000 ft. lengths, the weights of some of these machines exceeding 3,000 tons, represent giant plants the dimensions of which come near to those of large modern steel works and rolling mills.

"The grinding and polishing processes have been improved until an excellent quality of finish has been achieved and this with a much greater constancy than was secured previously by the old rotating apparatus. The travelling speed of the tables and the output of the grinding and polishing constructions depend, of course, on their lengths. An extensive line of tables with many grinding and polishing tools can work considerably faster than a short line. The customary speed lies between 100 ft. to 300 ft. per hour, i. e., the output that can be obtained is from 2 million to 20 million square feet per year, depending on the width. The continuous grinding and polishing apparatus being a means of mass production shows considerably better results in large units than in small.

"Details of the theoretical working conditions and polishing may be obtained from the report 'Arbeitskurven der Werkzeuge bei Spiegelglas-Schleif- und Polierbahnen' ('Working curves of the tools in rolled plate glass grinding and polishing lines'), which was given by Dr. Ing. Thomé, Aachen, at the 14th glass technical meeting of the Deutsche Glastechnische Gesellschaft from November 13th to November 15th, 1930, in Berlin. This report will be published before long in the *Glastechnische Berichte* der Deutschen Glastechnischen Gesellschaft in Franfurt/Main."

As regards the above mentioned U. S. patents 1,501,327 and 1,548,105 of the Pittsburgh Plate Glass Company and 1,582,808 of L. von Reis the following may be added: In the introduction to the chapter "The grinding and polishing of rough glass" and later, on different occasions, it had been pointed out that the polishing felts become greasy while they are used and encrusted from rouge and sometimes are filled with glass splinters, and that therefore frequent washing and cleansing of the felts is indispensable if a good and unimpaired polish is to be secured. As stated in the above report, this necessity of washing and cleansing the felts at first constituted a great obstacle to the carrying through of the continuous polishing process; it must be added that the felts wear out in a relatively short time and, therefore, must be renewed frequently. Thus it was of greatest importance upon the introduction of the continuous grinding and polishing lines to find ways of inspecting, cleansing and exchanging the felts without disturbing the continuity of the work.

According to U. S. patent 1,501,327 (Figs. 135 N and 135 O) the requirements are met through the suspension of the entire runner frame 13 in such a way that it can be tilted easily into an inclined position as indicated by the dotted lines in the figure. In this position the lower surfaces of the runner blocks can be examined easily, scraped, and cleaned, and every single block can quickly be supplied with new felts, if necessary. Paralleling the line of tables, a truck is located on a runway carrying a washing table 30, the plate of which is formed similar to a pan and can be slid under the tilted felts in order to protect the glass and the neighboring parts of the apparatus from dirty water, from hard crusts, glass splinters, etc., that must be removed. The truck carrying the washing table carries not only the water used for the washing, cleansing tools such as brushes, scrapers, etc., but fresh polishing blocks and various tools needed for exchanging them.

The rotating and suspending shaft 10 of the runner frame 13 is journaled with its upper and lower ends in the tubular support 9 which is suspended above with the trunnions 17 in the forked lever 15. The forked link 23 is provided with grooves 26 acting as guides for the trunnions 25 at the lower end of the support 9. Lever 15 and link 23 rest at 18 and 24 respectively in the bracket 2 which is adjusted to the main framework. In order to keep the runner frame 13 in a secure working position, i.e., to keep the shaft 10 and the tubular support 9 in their vertical positions, the trunnions 25 are held against outward movement in the grooves 26 by means of the two cap members 33 fixed to link 23. Before the runner frame is swung around the trunnions 17, it must be lifted by means of the hand wheel 22, the threaded spindle 20, and the lever 15. After the two cap members 33 have been released, the runner can be swung to the right into the position as indicated by the dotted lines. It is held in this position by means of the trunnions 25 which are hooked by the two latches 36 adjusted to the end of the link 23. In the two figures, the numeral 3 indicates the table carrying the glass to be polished, 11 the electric motors driving shafts 10 through the intermediary of reduction gearing located in the casing 12.

The U. S. patent 1,548,105 (Figs. 135 P, 135 Q, 135 R) attains the desired effect by adjusting every single block 47 to the runner frame 33 in such a way that it easily can be swung alone into the inclined position. The spindle 48 of the block 47 rotates in a pair of bearings 50 and 51 to which the links 53 and 54 forked at their ends are pivoted. The links 53 and 54 are also pivoted to the runner frame 33. If the block is to be swung outwardly, the bolt 57 is pulled out and the loosened end of the lower link is fastened with the bolt to the hole 58 of the runner frame. Thus, the inclined runner holds itself in a certain position. If another position is desired a piece of wood 59 may be put between.

This method of construction has, at the same time, the advantage that the felts, in spite of possible tiltings of the runner frame, are permitted to keep constantly in parallel relation with the glass surface, for the runners 47 are attached to the runner frame in such a way that they can freely move up and down in vertical direction. In order to make the movability of the runners a perfect one, they are connected to the spindles 48 by the ball joints 49. Moreover, the fact that the runners are mounted in the runner frame by means of pairs of links, permits for a convenient regulation of the pressure the felts apply to the glass. By reason of the centrifugal force the links tend to keep in horizontal position. When the runner frame is lowered (Fig. 135 S), this is followed by an increase of the pres-

sure which was previously caused by the weight of the block with its spindle and all its other parts. When, on the other hand, the runner frame is raised from normal position, the pressure is decreased (Fig. 135 T).

As can be seen from the pictures, the tilting devices of the patents described above can be installed advantageously only if the main frameworks which hold the runner frames are one-sided thus permitting access without hindrance from the other side. If the frameworks are double-sided as for instance in Fig. 129 (illustrating continuously-

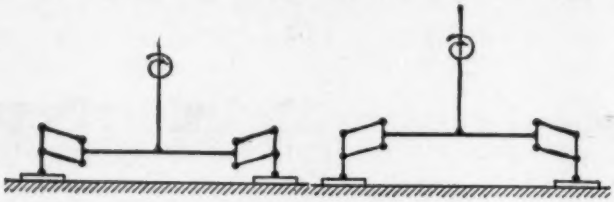

FIG. 135-S FIG. 135-T

working apparatus for grinding and polishing, built by Hooven-Owens Rentschler Company, Hamilton, Ohio), the tilting devices cannot well be used; nor are they convenient with very wide tables as may be seen in Fig. 135 B. For continuous polishing lines of this type the problem was solved in a successful way by U. S. patent 1,582,808. The solution found by this patent can be easily understood from Fig. 135 J and the explanations given there. One advantage of this solution is also that one may take one's time for the cleansing and exchanging of the felts without being obliged to defer noticeably the work on some point of the polishing line.

Returning to the rotary type of mechines, Figs. 136 to 138 show diagramatically the design of the grinding apparatus most frequently used for the simultaneous working of sheets of various dimensions, and fitted with replaceable grinding discs. The seat of the grinding table a consists of a circular groove b of wedge-form cross section, which groove fits the cone c of the king-shaft d. When the table has been so moved into the grinding apparatus that the circular groove b stands accurately above the cone c (which position can be regulated by buffers), the rail ends e with the aid of electrically or hydraulically operated spindles are lowered until the table with its groove b sits tightly on the cone c, releasing the runner flanges of the table wheels so that the latter can turn freely; alternately the whole king shaft d, inclusive of the cone c, is correspondingly raised by a hydraulic ram fitted into the support f, and the shaft d is then locked in its upper position.

The shaft d, together with the table, is rotated by means of the bevel wheels g, h and the belt drive i, which is either driven directly by a motor or from the main belting shaft. If driven by a separate motor the machine is started and stopped by the switching on and off of the motor; on the other hand, if driven through belting from the main line, a coupling k with an idler pulley is used which is also equipped with brakes in order to stop the table quickly in case of emergency. When raising and lowering the table together with the shaft and the cone, a straight gear is interposed (see Fig. 149) so that the engagement of the gear teeth is maintained. It has recently been suggested by Schild to replace the straight gear by a "globoid" drive, in which a worm is directly and elastically coupled to the motor shaft; see "Zeitschrift des Vereins Deutscher Ingenieure," Vol. 6, No. 22 of June, 1923, page 542.

The normal speed of the table with a machine as described is between 26 and 28 revolutions per minute.* In the ordinary way two grinding discs l and m are used which are fixed to the shafts o by means of three-armed spiders n; these shafts are guided in the lower bearings p and the upper bearings q of the frame r. The pins holding the grinding discs have some clearance in the vertical direction, so that,

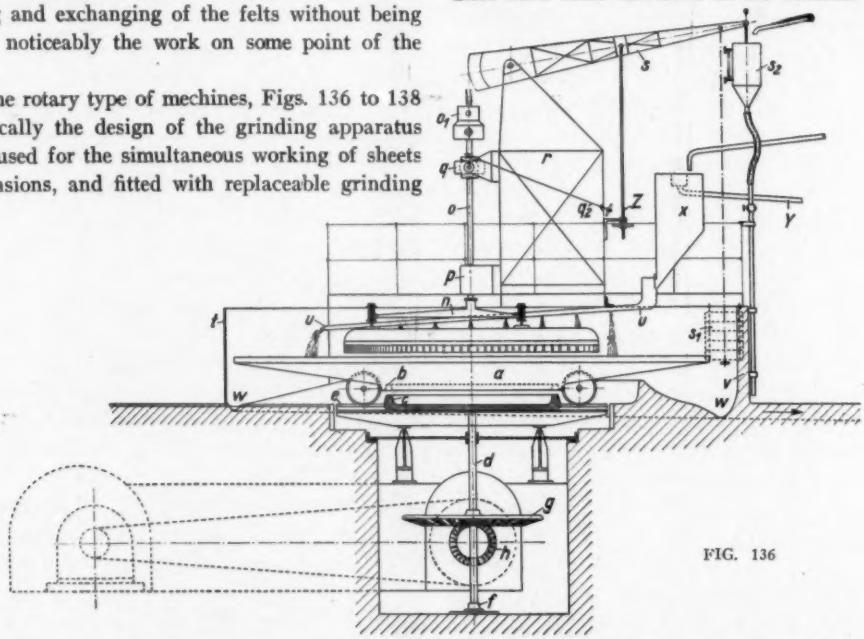

FIG. 136

if required, the spiders can be lowered so far that the discs rest with their full weight on the table.

The shafts o are suspended on levers s by means of which they can be lifted and lowered along with the grinding discs. For the sake of simplicity of the drawing the two grinding discs are assumed to be hanging on the same side of the truss r. Actually, however, for a better balancing of the

* This is too high for the large machines of this country.—F. W. P.

forces the truss will be arranged between the two shafts o,o or the two shafts are incorporated in the framework of the truss as shown in Fig. 150. Before the table is moved into the grinding machine the discs are fully raised, so that the shoulders of the spiders n touch the bearings p; after the table has been set in rotation and attained its full speed, the grinding discs are carefully lowered until the first contact with the highest points of the glass is made; at the same time sharp sand mixed with water drops from the gutter u on to the table. If the discs were lowered completely at the start, their weight would be taken up only by the few highest points of the glass surface and the glass would get crushed; apart from this the sheets might be broken by the hard clashing of the highest points with the iron runner bars. The flatness of the sheets, however, is such that very soon after the first contacts, the shafts o together with the grinding discs can be lowered somewhat further, so that the discs rest with a moderate pressure on the glass.

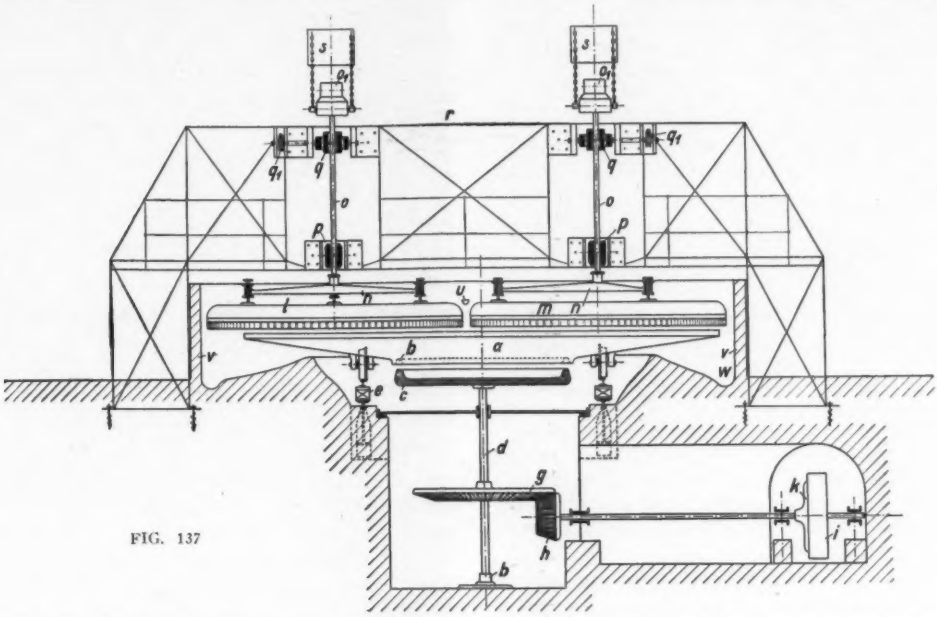

FIG. 137

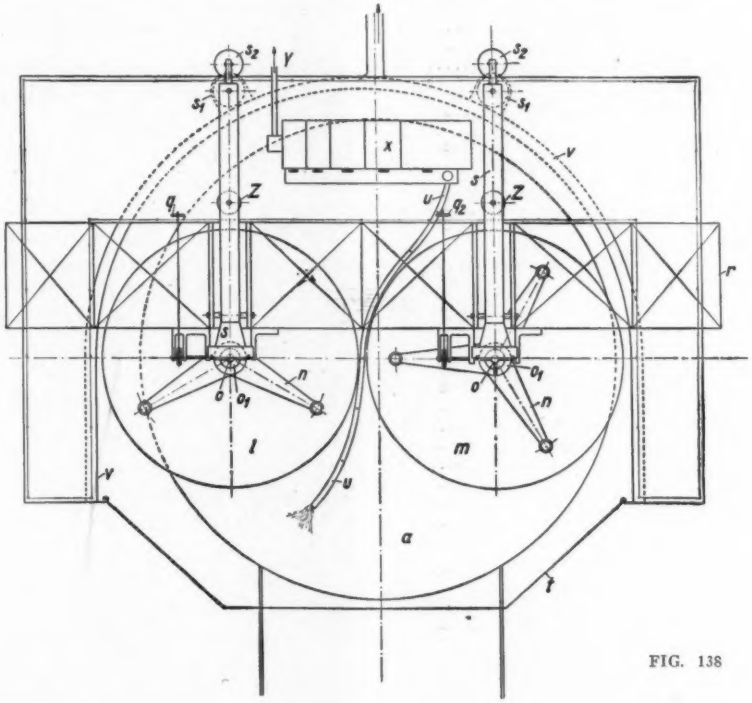

FIG. 138

(To Be Continued)

Glass Industry

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Reference to the contents of earlier issues of THE GLASS INDUSTRY can be found in THE INDUSTRIAL ARTS INDEX in many Public and Technical Libraries.

The Lament of the Tariffless

WEST VIRGINIA and Pennsylvania are adjoining states. The Dixie line runs between them, but the good Lord did not foresee this and put coal on both sides of the border.

Since the various "sovereign" states are joined in a larger nationality and subject to the federal powers (a thing they fought the Revolutionary war to prevent), coal comes across the Dixie line without being subject to tariff. It crosses only one way, from south to north, and Pennsylvania is howling about it.

Of course, it is a law of nature, for which I think we ought to forgive the deity, that coal is needed more in the North than in the South, the Great Lakes and New England needing more coal than Florida and Texas, so that it is natural for coal to move northward rather than southward. But Pennsylvania considers these northern states and Eastern Canada as her natural market, and wants to be protected in them.

The freight rates from West Virginia to these points are uniformly somewhat higher than those from Pennsylvania, but in Pennsylvania eyes the difference is not sufficient. Pennsylvania enjoys a slight advantage in freight rates, but it wants a greater one.

The distance from the West Virginia fields to the consuming points may average 50 per cent more to 100 per cent more than from Pennsylvania, and the railroads have acted unfairly in giving the West Virginians any chance whatever to compete.

Now if the Civil War had been a success and the South had seceded, the North could have erected a tariff barrier against West Virginia coal. It is notorious, say the Pennsylvanians, that the standards of living in West Virginia are low, and it is only by such low standards that Dixie coal can be dumped in New England and at Toledo in the natural hinterland of Pennsylvania.

As things stand, we cannot erect a tariff and therefore pressure must be put on the railroads to make the differential in favor of Pennsylvania greater. A citizens' committee has been formed for the purpose.

We believe a better way would be for Pennsylvania to petition the Federal Government to rescind the verdict of the Civil War and to declare that it was an oversight when Grant permitted Lee to surrender; that it was really Grant that should have surrendered, and in order to rectify the error we do hereby declare that the seceding states did in fact and do hereby forthwith secede and a tariff on West Virginia coal shall forthwith come into effect.

This is the way we deal with the cheap labor of Europe, Canada and other low down countries. We believe it should be equally effective against West Virginia.—*F. W. P.*

"Glass Universal"

A SHORT time ago *World's Work* carried an article entitled "Glass Universal" which is of interest to those connected with the glass industry because it lends an air of romanticism to what the majority are inclined to treat as commonplace. The author of the article, William Pickett

Helm, has the enviable ability of describing an involved manufacturing process in a manner which, to the lay-reader, is neither discouraging in detail nor confusing in technical terminology.

However, to those engaged in the technical side of the art it is not assuring to be told that the sand is a "powder almost as fine as talcum," or that "manganese tints the product green." Nor is there any excuse for the statement made with reference to the fact of gold-ruby glass being made from coin-gold, that "whether the gold or the alloys are responsible for the gorgeous coloring effect is as yet undetermined." We learn too that borax hardens glass against heat, which is news of a sort.

It is unfortunate that able and gifted writers in the field are often limited by technical shortcomings. But perhaps we should not be too critical, for the story is cleverly told in spite of the technical inaccuracies, and the illustrations are happily chosen to bring out the fascinating story of glass and the glass industry.—*D. E. S.*

The Laboratory

An Iodimetric Method for Selenites

By S. R. SCHOLES, Columbus, Ohio

SELENITES in acid solution (HCl, H_2SO_4) react with KI to liberate iodine, in common with other salts of oxidizing acids. This is the basis of a volumetric method for selenium proposed by Gooch (Scott, Methods of Chemical Analysis, Vol. I).

However, when the liberated iodine is titrated with thiosulfate, the selenium which is at the same time set free as a brown suspension obscures the end-point.

The writer has found that this titration can be conducted electrometrically. The end-point is indicated by a very sharp break in potential, in the opposite direction to the change in titrating ferrous iron with dichromate.

From the equation:

$H_2SeO_3 + 4HI = Se + 4I + 3H_2O$, it appears that in this reaction Se=4I, so that 1 ml. N/10 Thio. = .002 Se, very nearly.

In estimating the selenium in a glass sample, the method of Krak may be followed. The nitric acid evaporation must be carried to dryness, and it is preferable to add sulfuric acid and evaporate again to fumes of sulfuric acid. This will insure removal of nitrous acid, which will liberate iodine and lead to high results.

When properly carried out, and when freedom from other oxidizing acids can be made certain, this method is preferable to the gravimetric one. The latter involves reduction of selenium by sulfur dioxide and filtering off the element for drying and weighing. Errors arise from incomplete reduction, occlusions in the precipitated selenium and loss of selenium during the drying process.

Like all volumetric methods, this has an advantage in being rapid.

That Awful Bottle Man!

At the annual dinner of the Society of Glass Technology held at London last May, the President of the Society, Edward Meigh, in his address, read a poem which is of singular interest to the glass industry. The poem was written by the late John T. Osler in 1918, after returning from a conference of glass manufacturers at the Ministry of Labor. For those who have not had the good fortune to have heard or read the poem we reproduce it here in full.

Upon a pleasant morn in May,
Adown Whitehall I took my way,
To wrangle there among a mass
Of other men, who dealt with glass.
To bulbs and tumblers some were wed,
And some made X-ray tubes instead;
While others were impelled by fate
To roll their glass in sheet or plate.
And I remember one poor devil
Whose lot it was in life to bevel
The mirrors other people made,
A parasitic sort of trade.
I always thought the men I knew
A fairly contumacious crew,
But now I know we're mild as Quakers,
In contrast with the bottle-makers.
When once these gentlemen get loose,
Their skull in virulent abuse
Entirely puts into the shade
The language of the flint glass trade.
They went for one another's throttles,
Lord! How they fought, these men of bottles!
They said competitors were run
By machinations of the Hun;
That strings were pulled by hidden hands
In very hostile, alien lands.
They said a lot they didn't ought.
Lord! How the bottle-makers fought!
A Glasgow man, a lonely soul,
Who owned no syndicate's control,
Poured, with the accents of the North,
The hand-made vials of his wrath,
And all his bitter Scottish spleen
Upon the syndicate's machine;
And Chance & Pilkington sat tight,
And watched the bottle-makers fight!
Now when you've got your bottled Bass,
And poured it out into a glass,
Just moralize on those who made
These two essentials of "The Trade,"
And say with truth: I'm sure you can,—
Thank God! I'm not a bottle man.

Can Unemployment Be Cured?

Swarthmore College, a Quaker institution, influenced by the social-mindedness of the Society of Friends and backed by a group of Philadelphia's leading business men, has made an important practical contribution toward the solution of the Unemployment Problem by assembling an exhaustive collection of data on the subject from world sources. A vast amount of printed material including much on the subject, under discussion almost everywhere, and many reports of investigations, plans and similar matter has been gathered together and is being analyzed under a joint committee of members of the Swarthmore Board and business men outside the college group, and organized in such a way as to indicate the most promising lines of inquiry along which the best results might be secured. An unusually comprehensive library has been accumulated including international and

national reports, pamphlets, periodicals, leaflets, and much additional miscellaneous data.

The ideas behind the undertaking have been set forth publicly on various occasions. Over a year ago, Paul H. Douglas, Professor of Economics, University of Chicago, in an address made at Cape May, N. J. (abstracted in the *Friends Intellingencer* of August 9, 1930) pointed out the futility of permitting recurring periods of unemployment to exist and stated that Swarthmore had adopted a ten-year program to be concentrated upon the three problems of stabilization, public works, and protection, and that the co-operation of all persons of good-will in the venture was invited.

Further details of the Swarthmore project are given in the September, 1931, issue of Executives Service Bulletin (Metropolitan Life Insurance Company) in an article by Howard Cooper Johnson, Vice-President, Strawbridge-Clothier, Philadelphia, Pa., who points out the surprisingly small progress that has been made toward an understanding or control of this, perhaps the most serious of all problems facing the United States, and in fact the world. Magnificent attempts has been made on an unprecedented charitable scale to relieve widespread destitution, but all this effort, splendid as it was, has done almost nothing to improve conditions and thereby prevent a recurrence. Interest in the solution of the problem aroused in periods of depression is dissipated when business improves and the advent of the next depression finds the American public to be little, if any, better prepared.

The College is working earnestly to discover the best way to remedy the situation most effectively.

The announcement that a study of unemployment at Swarthmore had been instituted met a hearty response from leaders in all walks of life from the moment that it was made public.

Prof. Turner, Sailing Home, Sends Kindly Message

In reporting in the September issue the recent visit to this country of Professor W. E. S. Turner, head of the School of Glass Technology, The University, Sheffield, England, THE GLASS INDUSTRY was in error in stating that Professor Turner sailed home from Montreal after stopping on his way at Corning, New York. Under date of August 17 Professor Turner, aboard the steamship "Baltic," wrote autographically to the editor:

"I did not as I had originally intended embark at Montreal. The days at my disposal were so few that I had to pay such few visits as were possible, with such economy of time that the visit to my brother-in-law was left over for a Saturday and Sunday morning. However, I managed to catch the boat at Boston yesterday morning. . . . . .

"I have not yet recovered from the strenuousness of my tour though tonight I am feeling somewhat better rested. My work in Washington took not one but two full weeks and I had but one week available for myself instead of two. The heat at Washington was very trying and we kept very long hours, most days until 9, 10, or even 12 o'clock midnight in an endeavor to complete the work. My friends did all they could to help me through the trying heat; and much can be done by patience. . . . . .

"The one week left to myself saw me in Pittsburgh, Indianapolis, Anderson, Dunkirk, Zanesville, then to Buffalo and Corning, Montreal, Plymouth (Mass.) and Boston. Four nights were spent on trains; no two nights did I sleep in the same bed and on the last morning I was up at dawn because my brother-in-law had to begin his Sunday with a service at 7 A.M., Summer Time at a place 30 miles away and there was no train service. . . . . .

"My visits to New York are always made happy. . . . .

"My one regret is that my time with my friends has been so short and many I have not seen at all. For such as I have seen I am filled with pleasant memories. . . . . .

"Please remember me kindly to Messrs. Sharp and Preston. I was not fortunate enough to meet either of them on this trip."

Progress In Welded Steel Building Design

The General Electric Company has announced the opening at Schenectady of a school of welding design to teach engineers, architects, draftsmen, etc., both in and out of its employ, methods of designing welded buildings.

There is no charge for instruction in the course, which requires approximately four weeks for completion. It is a flexible one and can be adjusted to suit each individual. The course requires that the applicant be an engineer, or have some training in structural design or some experience in the design of riveted structures. It is then only necessary for him to learn the difference between the application of welding and riveting to steel frames.

The subject is approached from a scientific point of view based on studies and tests by the General Electric Company over a period of years in welding work, particularly in the construction of its own factory buildings. The following design problems are now being studied; typical Pratt truss; typical Warren truss; typical Fink truss; plate girder with concentrated and uniform loads; plate girder with concentrated moving loads; beam and girder connections involving various forms of brackets; column connections including base plates and miscellaneous frames as desired by the students. In addition, there are included special faetures within the limits of frame structures.

Interesting illustrations made from photographs showing tests made of full size steel roof trusses, building columns and other framed designs by The Austin Company of Cleveland, Ohio, were published in the March, 1930, issue of THE GLASS INDUSTRY. The Austin organization has, during the past several years developed a successful steel-welding department that has demonstrated its ability by erecting a number of industrial buildings on which welded joints were freely employed in the framework of the structures.

Gas Leakage Through Pyrometer Protection Tubes

The most widely used method of measuring high temperatures in industrial processes is by means of a thermocouple formed by the junction of two wires of different metals. When this junction is placed in the space the temperature of which is to be measured, an electromotive force is developed which depends on the temperature of this junction and on the material of the two wires.

Since the electromotive force of such a thermocouple at a given temperature varies with small changes in composition of the wires, exposure to furnace gases which produce changes in this composition leads to errors in the measurement of temperature. It is, therefore, necessary to place the wires in a protecting tube in order to avoid, or at least minimize, the effect of furnace gases. It is evident that the effectiveness of the protection afforded by such a tube depends on the rate at which gases leak through the walls.

The September number of the *Bureau of Standards Journal of Research* will contain a report of work recently completed on all the different types of pyrometer protection tubes which are on the market. The leakage through these tubes was measured at various temperatures up to 1,300 deg. C. or up to the limit which the particular tubes would withstand. The data so obtained are valuable as a guide to users of these tubes as well as to research workers performing experiments which require the use of an evacuated space at high temperatures.—*Technical News Bulletin*, Sept., 1931.

Tariff Investigation Again Postponed

The Tariff Commission at Washington announced on September 10 that the hearing set for September 29 in the investigation with respect to blown glass table, and kitchen ware, has been postponed at the request of parties interested to November 4, 1931, at 10 a. m. and 2:30 p. m., respectively. The meetings are to be held on the same day for the convenience of some of the parties interested in gauge glass tubes, as well as blown glass, permitting them to attend both.

An application for an investigation on cork insulation with a view to decreasing the duty on that product was received by the Commission on March 21 from the Luse Stevenson Co., Chicago, and Wicander Co., Inc., New York.

Recent Patents

NEW INVENTIONS DESIGNED TO IMPROVE GLASS AND THE MEANS OF PRODUCING IT

Complete copies of U. S. Patent Specifications may be obtained from the Commissioner of Patents, Washington, D. C., Price 10c each

PROCESS AND APPARATUS FOR MAKING COMPOSITE GLASS. U. S. 1,819,336. August 18, 1931. Nicholas J. Penning, Pittsburgh, Pa., assignor to Duplate Corp. Filed 2/21/29. Consists in assembling alternating sheets of glass and tough reinforcing material having their opposing surfaces prepared so as to become attached together upon the application of heat and pressure, applying protecting means to the edges of the assembled sheets and submerging such sheets in a bath of hot mercury under pressure.

MAKING SHEET GLASS. U. S. 1,824,474. Sept. 22, 1931. Samuel A. Forter, Bellevue, Pa., assignor to H. L. Dixon Company, Pittsburgh, Pa. Filed 3/28/27. Apparatus for making sheet glass including a container having at least two spaced machines with a chamber therebetween, at least one side of the chamber having a pair of inlet ports for heating gases and having an outlet port therebetween.

PROCESS OF AND APPARATUS FOR THE MANUFACTURE OF WIRE GLASS. U. S. 1,824,365. Sept. 22, 1931. Leander N. Pond and Joseph H. Lewis, Kingsport, Tenn., assignors to Blue Ridge Glass Corporation, Kingsport, Tenn. Filed 7/31/29.

APPARATUS FOR GRINDING, SMOOTHING, AND POLISHING GLASS. U. S. 1,824,347. Sept. 22, 1931. Charles Hibon, St. Maude, France, assignor to Societe Anonyme des Manufactures des Glaces & Produits Chimiques de Saint-Gobain, Chauny & Cirey, Paris, France. Filed 6/23/30 and in France 7/13/29.

METHOD OF AND APPARATUS FOR DRAWING SHEET GLASS. U. S. 1,815,473. July 21, 1931. Wayne E. Harding and Cecil C. Weekley, Fort Smith, Ark., assignors to Harding Glass Company. Filed 4/29/30. Means for drawing the sheet of glass upwardly through said slot, an agitator rotatably mounted in the glass bath beneath said slot and coextensive in length with the width of the sheet being drawn, and means for rotating the agitator.

LAMINATED GLASS. U. S. 1,818,159. August 11, 1931. James W. H. Randall, New York, N. Y., assignor to Libbey-Owens-Ford Glass Company, Toledo, O. Filed 2/24/28. A device for sealing laminated glass comprising a temperature control receptacle for containing the sealing material, an outlet therefor, and a heated wire onto which the sealing material flows.

AUTOMATIC FEEDER FOR GLASS MOLDING MACHINES. U. S. 1,824,197. Sept. 22, 1931. Tancredo De Biase, Buenos Aires, Argentina. Filed 6/7/28 and in Argentina 5/7/28. An automatic feeder, comprising an open-topped vessel to receive molten glass having a lateral discharge opening; a needle mounted above the open top of the vessel; means for positively tilting said vessel downward about a horizontal axis at regular intervals into position to aline the discharge opening with the needle; means for imparting a vertical reciprocating movement to said needle and thereby extrude a gob of glass; and means for severing the extruded gob and other objects.

APPARATUS FOR THE MANUFACTURE OF WIRE GLASS. U. S. 1,824,366. Sept. 22, 1931. Leander N. Pond, Kingsport, Tenn., assignor to Blue Ridge Glass Corporation, Kingsport, Tenn. Filed 9/6/30. In a device for the manufacture of wire glass, the combination with forming rollers having a forming pass between them, means for feeding glass to the forming pass, a netting feed roll adjacent to the upper forming roll, the two having a space therebetween for the passage of netting, the axis of the netting feed roll being in a horizontal plane below that of the upper forming roll and the netting feed roll having its center swelled in respect to its ends.

RECEIVING TABLE FOR CAST GLASS. U. S. 1,818,959. August 18, 1931. Claude Locreille, Fauquez, Belgium. Filed 3/27/30, and in Belgium 4/9/29. A table for casting and receiving glass plates and sheets, said table comprising a slab made of a concrete formed of a ground mixture of burned lime, silica and alumina, with fragments of porphyry embedded therein, said slab comprising a bottom layer having fragments of porphyry 20 to 30 mm. in size, intermediate layers with fragments respectively 10 to 20 mm. and 5 to 10 mm. in size, and a top layer containing pulverized porphyry, metal armatures embedded in each except the top layer, said armatures comprising transverse and longitudinal bars, circles and wire netting, and a metal band encircling said slab.

MEANS FOR FEEDING MOLTEN GLASS TO A ROLLING APPARATUS FOR PRODUCING A CONTINUOUS GLASS STRIP. U. S. 1,824,490. Sept. 22, 1931. Ernest Bristow Le Mare, St. Helens, and Frederic Barnes Waldron, Prescot, England. Filed 12/18/30 and in Great Britain 12/28/29.

The Glass World and What It Is Doing

News of the Industry

Feldspar Imports—Pro and Con

Importers of feldspar at the hearing on September 17 before the Tariff Commission at Washington claimed that the present tariff rates were a burden on consumers. The investigation had been applied for by the Consolidated Feldspar Corporation, Trenton, N. J., a large producer of domestic feldspar as well as being a large producer of Canadian feldspar, for a 50 per cent decrease in the present rate of $1.00 per ton for crude feldspar and 30 per cent ad valorem calling for ground feldspar.

V. V. Kelsey of the Consolidated organization informed the Commission that the Canadian product sells from $3 to $4 a ton higher than the American product because of higher production cost and freight charges on the foreign material. It was brought out that the Canadian competition is the only foreign factor of importance to the domestic producers. Henry N. Hanna of the Seaboard Feldspar Company stated that his company did not find the Canadian product seriously in competition with the domestic, which sells from $7 to $8 a ton lower than the Canadian spar. Bruce Taylor, representing the Genesee Feldspar Corporation testified along similar lines. C. H. Peddrick, United Feldspar Corporation, placed letters in evidence in which it was stated that the majority of feldspar grinders in the United States, representing an investment of over $4,000,000, do not sanction a decrease in the tariff and actually favor an increase. A retaliatory duty amounting to 30 per cent is in effect in Canada on imports of ground feldspar from the United States to offset the present duty on the crude product entering the United States. Mr. Peddrick stated that the price of feldspar in the United States will become ridiculously low in the future because large companies are being organized in Canada to extract from deposits which are largely composed of feldspar. Labor cost in Canada per man was reported to be $2.50 per day compared with $3.00 in the United States.

Fall Meeting American Refractories Institute

The American Refractories Institute will hold its regular Fall meeting October 8 to 9 at the Hotel Cleveland, Cleveland, O. On the 8th committee meetings only will be held and on the 9th the program calls for technical papers and discussions. The Institute through Miss Dorothy A. Texter, secretary, desires it to be known that all interested readers of the GLASS INDUSTRY are cordially invited to attend the technical sessions.

At the morning session, October 9, at 9:30 a. m., the following papers will be presented: Drying Press Operations, D. B. Hendryx, chief engineer, Harbison-Walker Refractories Company; Improving Dry Pressed Brick by the Removal of Air, Dr. George A. Bole, research professor Engineering Experiment Station, Ohio State University, Columbus, O; The Effect of Various Factors on Pressure Transmissions in Dry Pressing; Prof. C. M. Dodd, secretary, Committee on Dry Press Processes, Rolla School Mines, Rolla, Mo.

Afternoon session—Notes on Firing of Refractories, S. M. Kier, vice-president, General Refractories Company, Permeability of Refractories to Gas at High Temperatures, Stuart M. Phelps, director, Refractories Fellowship, Mellon Institute of Industrial Research; Open Session and Discussion on Firing of Refractories, Causes of Kiln Marking and Secondary Expansion.

The Refractories Division of the American Ceramic Society has issued through R. A. Heindl, chairman of the program committee, an invitation to submit questions for discussion at the next meeting of the Division, February 7, 1932, in connection with society annual meeting at Washington, D. C.

Railroad Freight Rates Argued at Washington

At a hearing before the Interstate Commerce Commission at Washington on August 13 speakers appeared both in favor of and in opposition to proposed increases in railroad freights affecting particularly chemical manufacturers and more or less indirectly the glass industry also. H. M. Mabey of New York, representing the manufacturing chemists, said the proposed increases would seriously dislocate industry and lessen railroad tonnage. William Martin of the Philadelphia Quartz Company contended that they would lower railroad revenues. J. C. Davie of the Gill Glass Products Company, Philadelphia, representing the Illuminating Glassware Guild, said his industry is one of the most depressed in the country working at only 27½ per cent capacity. Despite this condition he stated they are willing to pay their portion of the burden of increased rates. He thought that an increase in rates would inculcate a more cheerful note into the business situation, strengthen the railroad bond market and have a good psychological effect generally.

Mr. Davie said there was a general feeling among chemical manufacturers that business would improve this Fall, but when questioned by railroad representatives said he could give no definite indication of improvement. He held that increase in freight rates would tend to increase the decentralizing movement now in progress in the chemical industry, through the relocation of plants, and create a movement to ship by trucks and other cheaper forms of transportation as well as reduce long railroad hauls.

Hearing on New York State Natural Gas Industry

The State of New York Public Service Commission announced on September 16 that an investigation of all phases of the natural gas industry in the State of New York has been ordered by the Commission on its own motion to cover the rates, charges, rules, regulations, and practices relative to the production, transportation, sale and utilization of natural gas in the State. It is stated officially that a hearing on the subject will be held at 10 a. m., October 7, State Office Building, Albany, N. Y.

May Prohibit Natural Gas Pumping in Kansas

Attempts are being made in Kansas, asserts the State Public Service Commission, to induce the Attorney General to enforce an old statute prohibiting the use of artificial devices in taking gas from wells. The recent completion of large pipe lines connecting southwest Kansas gas fields with Eastern cities has created an unusual situation. The supply of gas from wells drilled is greater than the demand even with two big pipe lines, and the producing companies are not drilling more wells due to the economic depression. Some producers, it is said, are using pumps to take more than the normal capacity of gas from wells already drilled in order to obtain the largest possible supply that can be drilled within the one-year clause contained in many leases.

Stabilizing the Bituminous Coal Industry

Plans similar to those of the Interstate Oil compact recommended by the Federal Oil Conservation Board to oil producing states were put before President Hoover at the White House on September 24, by representatives of the Continental Coal Company, Fairmont, W. Va., and lumber interests in Chicago. It is said that the Governors of Pennsylvania, West Virginia, Kentucky, have already interested themselves in the progress and the Governor of Ohio has been invited to participate. It is proposed that the Governors of the four states appoint committees of three to five coal operators to meet immediately and study various suggested plans for stabilizing the industry.

Dr. Scholes Inaugurates Consulting Service

Dr. S. R. Scholes, until recently technical director with the Fostoria Glass Company, recently has announced that he has started a consulting practice. His new address is 1565 Lincoln Road, Columbus, Ohio, Telephone—Univ. 1024—W. During his long career in the glass manufacturing field Dr. Scholes has made a large number of friends, his writings and personal advice on glassmaking problems having been a very substantial help to his fellow-workers in this field. All of Dr. Scholes' many friends, thoroughly cognizant and appreciative of his professional and practical abilities will wish him the best of success in his new venture.

R & H Personnel Transfers

The following members of the research staff of The Roessler & Hasslacher Chemical Company, Incorporated, have been transferred from the plant at Perth Amboy, N. J., to the Niagara Falls, N. Y., plant within the past three months: Dr. Sterling Temple, Dr. B. S. Lacy, Dr. A. M. Muckenfuss, Dr. J. F. Reichert, Dr. C. J. Wernlund, A. T. Hawkinson, A. W. Rudel, J. M. Wainscott, H. A. Bond.

Other transfers to the Niagara Falls plant include: From Perth Amboy—P. M. Paulson, Patent Specialist; M. Marean, Librarian. From the New York office—I. L. Ressler, Entomologist.

Shortage of Jars Curtails Preserving Operations

Reports from various sections of the country indicate that there has been an acute shortage of fruit jars, tubes, rubber rings and other supplies and that preserving of food products has been seriously interfered with. R. F. Coningham of Owens-Illinois Glass Company at Toledo is reported to have stated that the demand for glass jars is ten times larger than at any time since 1920. Thirty-five carloads of glass jars have been used this season and eleven million fruit jar rubbers have been insufficient to supply the demand. Instances of some families using five thousand jars each have been brought to light. Many wholesalers' stocks of supplies were exhausted early in the season.

Well-Known Advertisers Aid Navy Ship "Akron"

"A most wonderful and impressive sight" was the conclusion reached by a member of THE GLASS INDUSTRY staff after visiting the new Navy Airship, "Akron" at the factory and dock of its builders the Goodyear-Zeppelin Corporation, Akron, O., and observing its flight over that city on the night of September 27. It was learned that Wellman Engineering Co., Cleveland, O., furnished the big door-opening apparatus at either end of the enormous structure housing the ship, and Pittsburgh Plate the glass used in the control room.

Illuminating Engineering Society

The Illuminating Engineering Society's silver anniversary convention will be held at the Hotel William Penn, Pittsburgh, Pa., October 12-16, 1931. Sessions will be held on architectural lighting, aviation lighting, lighting service, lighting practice, and the program will include inspection trips. Full particulars may be had from A. W. Robertson, chairman

General Convention Committee, Westinghouse Electric and Manufacturing Company, Pittsburgh, Pa.

Big Safety Congress at Chicago

The 20th Annual Safety Congress and Exposition to be held in Chicago, October 12-16, will include 130 sessions with more than 300 speakers. It will be the most extensive and fully rounded Safety Congress ever held. An advance story of the program for the chemical industries has been issued by T. A. Burke, director of publicity, 20 North Wacker Drive, Chicago. The exhibit will include more than 100 displays, for example; many standard types as well as special protective equipment for use in all emergencies.

C. B. Roe on Manufacturers' Committee

C. B. Roe, president of the Fostoria Glass Company, Moundsville, W. Va., has been nominated, along with Charles F. Boehler of the Seneca Glass Company, W. Hume Logan, Louisville, Ky., and W. D. Ord, Landgraf, W. Va., to represent West Virginia and Kentucky manufacturers as a group for the year 1932 on the board of directors of the National Association of Manufacturers.

Trade Activities

Butterworth Bros., Ltd., Newton Heath Glass Works, Manchester, England, who for nearly seventy years have been engaged in the manufacture of glass of all kinds, announced under date of July 9, 1931, that they have purchased the business of Messrs. J. Humphreys & Sons, Press and Mold Makers of Hulme, Manchester, long established and esteemed in that line of business. Their name, good will, plant, stock, and special machinery is included in the purchase. The mold-making department at Newton Heath Glass Works has been enlarged to take care of any and all orders that may be received.

The Standard Plate Glass Corporation, recently chartered, has obtained a lease of the old Standard Plate Glass Company's plant at Butler, N. J., through George C. Stewart, chairman of the committee formed to reorganize the company and continue the plant in operation it is said as a plant for the manufacture of a sheet glass. The new organization, it is reported, obtains the use of the plant for eight months with the privilege of renewal for six months and the right to purchase the property at any time during the term of the lease for $500,000.

The American Plate Glass Corporation, Kane, Pa., was, it is reported, put into the hands of M. L. Peterson of that city as receiver on September 24. It is stated that two equity suits had been filed against the company by Norman D. Howells and D. V. Crossmire of Kane. The value as stated for the company's properties is approximately $2,000,000.

Recent Deaths

Dr. Theodore C. Wheaton

Dr. Theodore C. Wheaton, president of the T. C. Wheaton Company, manufacturers of glassware, Millville, N. J., died September 7 at his summer home, Sea Isle City, N. J. Dr. Wheaton was 79 years of age. Before he entered the glassmaking business 40 years ago he was engaged in the practice of mdicine in Southern New Jersey. He was always interested in philanthropic projects and was especially interested in the welfare of crippled children. He was a 32nd degree Mason. He was survived by his sons Frank Wheaton and Theodore C. Wheaton, Jr., and a daughter, Mrs. James Anderson. Funeral services were conducted at his home in Millville, N. J.

B. F. Drakenfeld, Jr.

After a short illness B. F. Drakenfeld, Jr., president of B. F. Drakenfeld & Co., Inc., died at his home in New York, Friday afternoon, September 4. Although Mr. Drakenfeld's health had not been of the best for several years, the end came suddenly and was a great shock to his family and associates. He is survived by his mother and by his sister, Mrs. E. O. Beyer.

Bernard Ferdinand Drakenfeld, Jr., was born in California in 1878. His education included study at a number of technical schools in Germany as well as in this country. In 1898 he joined his father's company. In 1913, following the death of his father, B. F. Drakenfeld, Jr., became the active head of the company which bears his father's name and continued in that capacity until the time of his death.

B. F. Drakenfeld, Jr., belonged to the Chemist Club and Hardware Club of this city as well as the Greenwich Country Club of Greenwich, Conn.

Alexander Hill Barry

Alexander Hill Barry, secretary-treasurer of the Stewart-Carey Glass Company, Indianapolis, Ind., was found dead at the company's plant on Friday, September 4.

Coming Meetings

The Eastern Division of the National Glass Distributors Association is holding their fall meeting at Atlantic City, September 23-25, as this edition goes to press.

The American Refractories Institute will hold its regular Fall meeting October 8 to 9 at the Hotel Cleveland, Cleveland, O.

The Industrial Marketing Conference to be held in Cleveland will meet on November 11-13, 1931, at Hotel Statler, the date for the meeting having been recently changed.

American Bottlers of Carbonated Beverages, as announced by National Secretary, Junior Owens, Washington, D. C., will hold their annual convention and exposition at Dallas, Texas, Nov. 9-12.

Inquiries Received

For further information address THE GLASS INDUSTRY.

562. I am interested in quotations on plate glass disks for making telescopic mirrors. Also prices on Huyghen Telescopic Eyepieces and the price of a 90 degree complete reflection prisms 1", 1¼", 1½" and 2".

What the World Wants

Specific Inquiries for American Goods Received in the Department of Commerce, Washington, D. C. For further information write the department.

Canada—53431. Glass, flat.

Argentina—53502. Glass, sheet, including stained, prismatic, and beveled glass.

Austria—53856. Burners, oil, industrial.

Canada—53862. Burners, oil, industrial.

South Africa—53886. Glassware.

Spain—53944. Glassware and china.

Canada—53817. Glassware, china ware, gifts, novelties, and notions, for department stores.

Canada—53553. Glass beads, balls, pendants, etc., for decorating chandeliers and other electric lighting fixtures.

Domestic—53624. Glassware, colored.

China—54040. Neon tube and sign board making machinery and supplies, vacuum pumps, and neon transformers.

Porto Rico—54041. Glass bottles and jars for pharmaceutical and other purposes.

New Zealand—53731. Glass jars, with screw tops.

Readers Wants and Offers

Address answers to all "keyed" ads c/o The GLASS INDUSTRY, 24 West 40th St., New York

SITUATION WANTED

By Glass Technologist and Engineer, as factory manager, now employed. Many years' experience on both plain and colored glass, tanks and pot furnaces. Would like to get in touch with some progressive company who want to do things. Address Box O-1, as noted above.

Current Prices of Glass-Making Materials

September 21, 1931

Quotations furnished by various producers, manufacturers and dealers.

Acid		Carlots	Less Carlots
Citric (dom.)	lb.	..	.35
Hydrochloric (HCl) 20° tanks, per 100 lb		..	1.10
Hydrofluoric (HF) 60% (lead carboy)	lb.	..	.12½
52% and 48%	lb.	.10	.10-.11½
Nitric (HNO_3) 38° carboy ext. Per 100 lb.		5.50	..
Sulphuric (H_2SO_4) 66° tank cars	ton	15.50	..
Tartaric	lb.	..	.27½
Alcohol, denatured	gal.	..	..
Aluminum hydrate ($Al(OH)_3$)	lb.	.04½-.05	.05½-.06
Aluminum oxide (Al_2O_3)	lb.	..	.07
Ammonium bifluoride (NH_4) FHF	lb.	..	.15½
Ammonia water (NH_4OH) 26° drums	lb.		
Antimony, metallic (Sb)	lb.	.02½	.02¾
Antimony oxide (Sb_2O_3)	lb.	..	.09½
Antimony sulphide (Sb_2S_3)	lb.	..	.08½
Arsenic trioxide (As_2O_3) (dense white), 99%	lb.	.04	.14 .04½
Barium carbonate ($BaCO_3$), Crude, (Witherite) 90%, 99% through 200 mesh	ton	47.00	..
90% through 100 mesh	ton	44.00	..
Barium hydrate ($Ba(OH)_2$)	lb.	..	.05¼
Barium mixture, glassmaker's, f.o.b. St. Louis	ton	25.00	..
Barium nitrate ($Ba(NO_3)_2$)	lb.	..	.07¼
Barium selenite ($BaSeO_4$)	lb.	..	..
Barium sulphate, in bags	ton	19.00	24.00
Barium sulphate, glassmaker's, carlots, bulk, f.o.b. shipping point,	ton	15.00-16.00	18.00
Bone ash	carlots, lb.	.06	.06½
Borax ($Na_2B_4O_7 10H_2O$)	lb.	..	.0355-.0425
Crystal	lb.	.028-.033	..
Granulated	lb.	.025-.03	..
Powdered	lb.	.02875-.03375	..
Boric acid (H_2BO_3)	lb.	.0625-.07125	.0625-.08125
Refined	lb.	0625-.07125	.07125-.08125
Cadmium sulphide (CdS)—			
Red	lb.	..	.65-.90
Orange	lb.	..	.60-1.10
Yellow	lb.	..	1.30-1.50
Chromium oxide (Cr_2O_3)	lb.	.23	.24
Cobalt oxide (Co_3O_4)			
In bbls.	lb.	..	1.35-1.45
In 10 lb. tins	lb.	..	1.45
Copper oxide			
Red (Cu_2O)	lb.	..	.25
Black (CuO)	lb.	..	.17-.19
Black prepared	lb.	..	.22
Cryolite ($Na_3Al F_6$) Natural Greenland			
Kryolith)	lb.	.09	.09¼
Synthetic (Artificial)			.09½
Epsom salts ($MgSO_4$) (imported) Per 100 lb.		..	1.15-1.20
*Feldspar—			
100 mesh	ton	11.50-17.50	12.00-18.00
80 mesh	ton	11.00-11.50	13.00
40 mesh	ton	10.75-11.00	12.00
20 mesh	ton	9.50- 9.75	10.00
Fluorspar (CaF_2) domestic, ground, 96-98% (max SiO_2, 2½%)			
Bulk, carloads, f.o.b. mines	ton	30.00	..
In bags or barrels	ton	34.00	39.00
Imported	ton	30.00-31.00	33.00-37.00
Formaldehyde	lb.	..	.07
Graphite (C)	lb.	..	.04-.07
Iron oxide—			
Red (Fe_2O_3)	lb.	..	.0425
Black (FeO)	lb.	.04½	..
Kaolin (f.o.b. mine)	ton	8.00-9.00	..
English, lump, f.o.b. New York	ton	14.50-25.00	24.50-30.00

*Spot Shipments.

Kryolith (see Cryolite)		Carlots	Less Carlots
Lead chromate ($PbCrO_4$)	lb.	..	30
Lead oxide (Pb_3O_4) (red lead)	lb.	.069	.07¾
Litharge (PbO)	lb.	.059	.06¾
Lime—			
Hydrated ($Ca(OH)_2$) (in paper sacks)	ton	7.00	7.00
Burnt (CaO) ground, in bulk	ton	6.00	..
Burnt, ground, in paper sacks	ton	8.00	8.00
Burnt, ground, in 280 lb. bbls.	Per bbl.	2.15	..
Limestone ($CaCO_3$)		1.50-2.50	1.75-2.50
Magnesia (MgO)—			
Calcined, heavy (in bbls.)	lb.	.06	.07
light (in bbls.)	lb.	..	.23
extra light (in bbls.)	lb.	..	.37
Magnesium carbonate ($MgCO_3$)	lb.	.06	.10
Manganese 85% (MnO_2)	lb.	.03	.03
Nickel oxide (Ni_2O_3), black— for nickel content	lb	..	.35
Nickel monoxide (NiO), green— for nickel content	lb	..	.35
Plaster of Paris, bags	ton	21.00	23.00-29.00
Potassium bichromate ($K_2Cr_2O_7$)—			
Crystals	lb	.09	.09¼
Ground	lb	.11	.12
Potassium carbonate—94-96%	lb.	.0555	.0555
Calcined (K_2CO_3) 96-98%	lb.	.06½	.07¼
Hydrated 80-85%	lb.	.05¾	.06¼
Potassium chromate (K_2CrO_4)	lb.	..	.25
Potassium hydrate (KOH) (caustic potash)	lb.	.07¼	.08
Potassium nitrate (KNO_3) (gran.)	lb.	..	.06½-.06¾
Potassium permanganate ($KMnO_4$)	lb.	.16	.17
Powdered blue	lb.	..	.17½-.18
Rochelle salts, bbls.	lb.	..	.19
Rouge	lb.	..	..
Rutile (TiO_2) powdered, 95%	lb.	.15-.20	20-.25
Salt cake, glassmakers (Na_2SO_4)	ton	22.00	..
Selenium (Se)	lb.	..	1.80
Silver nitrate ($AgNO_3$) (100 oz.)	per oz.	..	.21¾
Soda ash (Na_2CO_3) dense, 58%—			
Bulk, on contract	Flat per 100 lb.	1.07½	..
In barrels	Per 100 lb.	1.38	1.90-2.00
In bags	Per 100 lb.	1.17½	1.72½
Spot orders	.025 per 100 lbs. higher	..	..
Sodium bichromate ($Na_2Cr_2O_7$)	lb.	.07	.07½
Sodium hydrate (NaOH) (caustic soda) Solid	Per 100 lb.	2.50	..
Sodium nitrate ($NaNO_3$)—			
Refined (gran.) in bbls.	lb.	.03⅞	.04½
95 per cent.	Per 100 lb.	2.01½-2.05	2.06½-2.10
Sodium selenite (Na_2SeO_3)	lb.	..	2.00
Sodium fluosilicate (Na_2SiF_6)	lb.	.04	.04½
Sodium uranate (Na_2UO_4) Yellow or Orange	lb.	..	1.50-1.55
Sulphur (S)—			
Flowers, in bbls.	Per 100 lb	3.45	3.80-4.00
Flowers, in bags	Per 100 lb	3.10	3.45-3.65
Flour, heavy in bbls.	Per 100 lb	2.85	3.20-3.40
Tin chloride ($SnCl_2$) (crystals)	lb.	.37½	.39
Tin oxide (SnO_2) in bbls.	lb.	.28	.29½
Uranium oxide (UO_2) (black, 96% U_3O_8) 100 lb. lots. Black	lb.	..	2.75
Yellow	lb.	..	1.50
Zinc oxide (ZnO)	lb.	.08½	.12
American process, Bags	lb.	.06½	.07
Zircon			
Granular (Milled .005-.02c higher)		.07	.07½-.08
Crude, Gran. (Milled .005-.02c higher)		.03½	.04-.05

Monthly Summary of United States Foreign Commerce in Glass

EXPORTS

Corrected to August 25, 1931.

	July 1930 Quantity	July 1930 Value	July 1931 Quantity	July 1931 Value	Seven Months Ending July 1930 Quantity	Seven Months Ending July 1930 Value	Seven Months Ending July 1931 Quantity	Seven Months Ending July 1931 Value
Glass and glass products (Total)	.....	$719,043	.....	$505,424	.....	$5,502,065	.....	$4,503,687
Plate and window glass—								
Window glass, common, box 50 sq. ft.	518	2,694	420	1,901	10,679	57,141	5,117	31,534
Plate glass, unsilvered, sq. ft.	355,287	112,682	248,897	69,194	2,145,894	653,781	2,497,678	760,280
Other window and plate glass lbs.	530,626	35,553	122,328	10,168	3,142,913	284,631	1,829,859	193,986
Glass containers (bottles, vials and jars)	.....	253,731	.....	192,993	.....	1,760,303	.....	1,308,219
Table glassware, plain	.....	81,041	.....	63,200	.....	722,587	.....	551,294
Table and other glassware, cut or engraved	.....	4,593	.....	7,838	.....	54,215	.....	53,224
Lamp chimneys and lantern globes lbs.	.....	24,116	.....	7,236	.....	145,318	.....	62,221
Globes and shades for lighting fixtures lbs.	.....	41,373	.....	25,772	.....	369,891	.....	260,140
Chemical glassware lbs.	20,041	18,977	13,896	14,670	140,325	131,537	90,408	90,926
Electrical glassware, except for lighting lbs.	120,091	9,086	107,177	6,907	2,800,308	182,706	1,010,923	65,860
Other glassware	.....	135,197	.....	105,545	.....	1,139,955	.....	1,126,003

IMPORTS

Corrected to August 25, 1931.

Glass and glass products	.....	613,712	.....	498,722	.....	5,231,726	.....	3,503,901
Cylinder, crown, and sheet—								
Plain dut. lb.	469,575	22,704	690,464	26,482	11,282,425	446,699	5,113,859	196,355
Bent, beveled, colored, etc. dut. lb.	314,866	27,636	87,985	15,029	.....	227,226	1,153,155	154,325
Plate glass dut. sq. ft.	244,707	55,372	487,424	81,612	3,432,527	753,828	3,199,174	821,343
Glass mirrors	165	225	143	515	165	225	953	2,399
Rolled, cylinder, crown, and sheet glass, ground, obscured, bent, beveled, colored, etc.	.....	2,312	.....	16,693	.....	4,614	.....	46,141
Laminated glass and manufactures, and plated glass	.....	2,797	.....	1,945	.....	4,784	.....	15,201
Bottles, vials, jars, and other containers	.....	68,997	.....	43,606	.....	768,384	.....	290,770
Scientific articles and utensils dut.	.....	40,655	.....	39,419	.....	338,853	.....	238,193
Tubes and rods dut.	.....	6,975	.....	12,846	.....	10,399	.....	73,636
Illuminating articles dut.	.....	41,278	.....	28,722	.....	368,037	.....	217,230
Blown glass articles—								
Bulbs for electric lamps, without filament dut.	.....	.....	907,937	8,244	.....	.....	8,145,368	77,305
Other blown glass articles dut.	.....	.....	.....	144,415	.....	.....	.....	797,075
Pressed glass articles	.....	12,187	.....	9,490	.....	95,287	.....	68,835
Other glassware	.....	99,133	.....	69,704	.....	652,294	.....	505,093